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Circadian Clock Involvement in Zooplankton Diel Vertical Migration

Key Messages

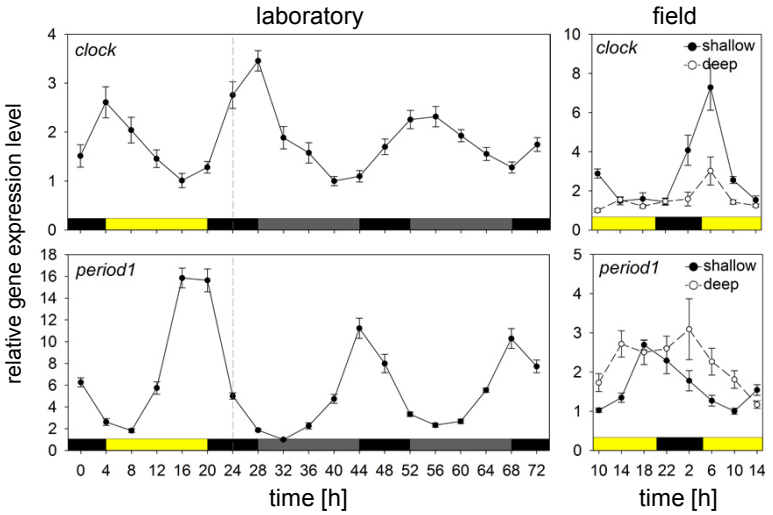
- The northern Atlantic key copepod *Calanus finmarchicus* possesses an endogenous circadian clock that is functioning under field conditions and affects diel phenotypic rhythms including diel vertical migration (DVM).
- To understand marine rhythms of life and how they will be affected by climate change, a mechanistic understanding of marine clock systems will be crucial, especially for key species like *C. finmarchicus* that drive ecosystem functioning.

Reasoning

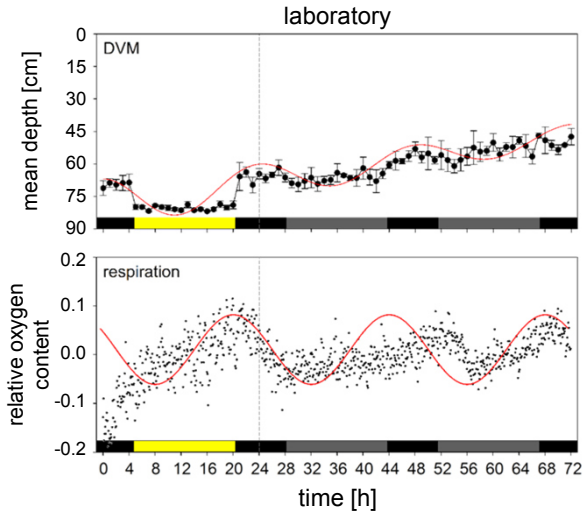
- Endogenous clock are crucial for the control of biological rhythms like diel behavioural cycles or seasonal life cycles, but they have hardly been addressed in marine organisms[1,2].
- The DVM of zooplankton is central in shaping marine pelagic ecosystems and carbon flux in particular, but the factors controlling this 24h rhythm are still poorly understood[3,4].
- *C. finmarchicus* is a northern Atlantic ecological key species with a highly rhythmic diel and seasonal lifestyle that includes DVM.

Approach

To determine if *C. finmarchicus* possesses a functioning circadian clock and how it affects DVM, diel rhythms in clock gene expression, metabolic activity and DVM behaviour were monitored in the laboratory. Diel clock gene patterns were also investigated in a DVM-performing *C. finmarchicus* field population in Loch Etive, Scotland.



Expression of the genes *clock* and *period1* in *C. finmarchicus*. **In the laboratory**, copepods were kept under a natural light/dark cycle for one day, followed by two days of constant darkness. **In the field**, expression was measured in shallow (5-50 m) and deep waters (50-140 m). mean ± SE is shown. 6 out of the 8 investigated clock genes showed persistent diel rhythmicity.



Circadian rhythms in *C. finmarchicus* DVM and respiration. Copepods were kept under a natural light/dark cycle for one day, followed by two days of constant darkness. **Phenotypic rhythms** persisted under **constant darkness** (red curves added for illustration).

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